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Conservation through research and education

INTRODUCTION

The Eastern Massasauga (EMR) is a small rattlesnake native to the eastern and midwestern U.S. as well as Canada. It is a protected species throughout its entire range due to loss of suitable habitat and persecution. The preferred body temperature range for EMRs is 30.0-33.6 ^{o}C [2], where most physiological functions are optimized. Previous research has shown EMRs are often thermally constrained by cool average temperatures in northern latitudes[1]. Woody plant succession can also threaten critical EMR basking habitat[4], which is essential for gestating females.

OBJECTIVES

We aimed to determine the seasonal variation in body temperatures of EMRs spanning multiple years, the relative influence of habitat selection on thermoregulation and the accuracy to which EMRs thermoregulate at temperatures within their preferred temperature range at a differing site near their northern range limit.

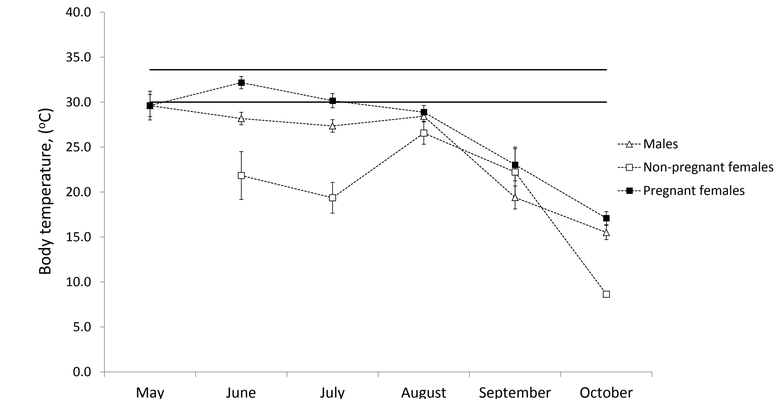

Figure 1. Monthly (mean ± SE) body temperatures of Eastern Massasaugas by sex class in Grayling, MI during 2013. The preferred temperature range is shown for reference by horizontal bars.

METHODS

EMRs were implanted with a temperature-sensitive radio transmitter and tracked during the 2006, 2007 and 2013 activity seasons at Grayling, MI. When EMRs were relocated, the pulse rate of each transmitter was taken twice at each relocation. Mean pulse rates were later transformed into internal body temperature data using polynomial regression equations (up to degree four, R^2 >0.99 for all equations). The accuracy of thermoregulation is an index which measures how close body temperatures are, on average, to the preferred range[3]. Macrohabitats within the study area were classified largely on percentage of overstory canopy cover. Barren, Burn and Clear-Cut had no canopy cover, Forest contained over >50% and Shrub-Scrub contained <30%. Edge, the 15m boundary between an open and closed canopy habitat, was variable.

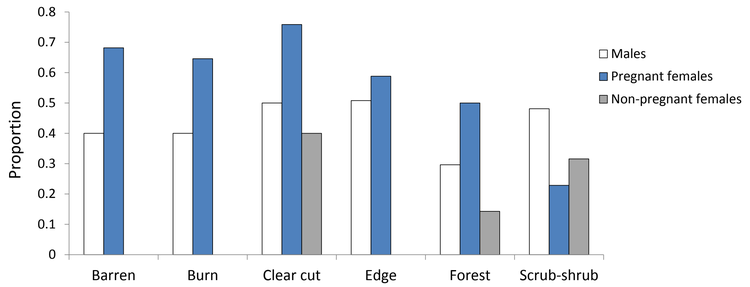

Figure 2. Proportion of body temperatures exceeding the lower bound of the preferred temperature range based on the macrohabitat selected by Eastern Massasaugas in Grayling, MI during 2013. Note that a bar is not present if the body temperature never exceed the lower bound of the preferred range or that habitat was not selected for a particular sex class.

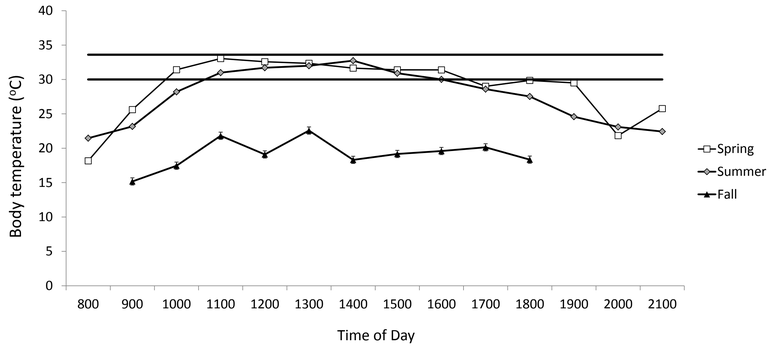

Figure 3. Seasonal variation (hourly means ± SE) in body temperatures of Eastern Massasaugas in Spring, Summer and Fall at Grayling, MI during 2006-07 and 2013. The preferred temperature range is shown for reference by horizontal bars.

2013 RESULTS

500 relocations, and thus body temperatures, were recorded from 14 individuals. Although not significant, pregnant females (n=5) thermoregulated at higher mean monthly temperatures as well as temperatures closer to or within the preferred range than males (n=7) and non-pregnant females (n=2) throughout the entire activity season, even following parturition in mid-August (**Fig. 1**). Pregnant females thermoregulated proportionately more at temperatures exceeding lower bound of the preferred range in habitats with no overstory canopy cover (**Fig. 2**).

2006-07 and 2013 RESULTS

2,393 relocations from 48 individuals were recorded. During the day, EMRs thermoregulated at temperatures within the preferred range more frequently (**Fig. 3**) and more accurately **(Fig. 4**) during Spring (May and June) and Summer (July and August) compared to Fall (September and October).

CONCLUSIONS AND DISCUSSION

Pregnant females select open habitats presumably for their warmer temperatures and the need to promote proper gestation of young, thus potentially enhancing recruitment. Males and non-pregnant females may forfeit thermoregulatory opportunities when foraging or mate searching[1]. EMRs have a limited window to thermoregulate within the preferred temperature range during the day. In light of global climate change, understanding the thermal ecology for different EMR populations throughout its range can help guide landscape management decisions, enhancing conservation measures for this imperiled species.

FUTURE WORK

During the 2014 field season, we will incorporate automatic data loggers to continuously monitor body temperatures of multiple individuals during the activity season. We will also deploy biophysical models (painted copper pipes with internal temperature data loggers) in the field to determine operative environmental temperatures available to EMRs in all habitats.

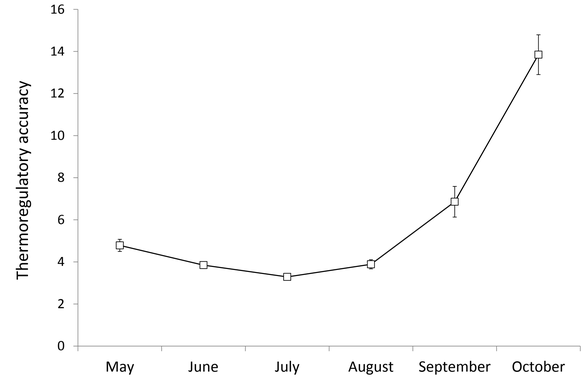

Figure 4. Monthly thermoregulatory (mean ± SE) accuracy of Eastern Massasaugas in Grayling, MI during 2006-07 and 2013.

ACKNOWLEDGEMENTS

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